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Analysis of the D_2O Absorption Spectrum near 2.5 μm

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The D_2O absorption spectrum recorded with a selective modulation Girard spectrometer in the region of 3690–4190 cm^{-1} (resolution ~0.07 cm^{-1}) has been analyzed. Based on the fitting of experimental data the spectroscopic parameters of the vibrational state (011) have been determined and the parameters of the vibrational states (110) and (030) have been estimated.

1. INTRODUCTION

The analysis of vibration–rotation absorption spectra of the isotopic species of water vapor is of great interest for investigating the dynamics of molecular vibrations and rotations, for determining the intramolecular potential function, for studying the role of deuterium in interstellar molecules as an indicator of chemical reactions, and for analyzing the content of these isotopic species in different media using laser techniques.

This paper deals with the analysis of the D_2O absorption spectrum near 2.5 μm. The D_2O spectrum in this region was studied earlier in Ref. (*1*) using classical grating spectrometers with spectral resolution between 0.25 and 0.3 cm^{-1}. However, the investigation of the D_2O spectrum at higher resolution is of interest.

2. EXPERIMENTAL DETAILS

In this paper the D_2O absorption spectrum has been recorded using an apparatus which is a modified setup of the instrument described in Ref. (*2*), and which is based on a selective modulation Girard spectrometer with a focal length F = 200 cm. A globar was used as a source of continuous radiation. The recording was carried out with a dry-ice-cooled PbS photoresistor. The measurements were made with a grating spectrograph with 300 grooves/mm used in the second order. The resolution was around 0.07 cm^{-1}.

The centers of the D_2O lines were determined with reference to the H_2O and HDO absorption lines whose centers were taken from Refs. (*3, 4*). The accuracy of the line centers is ~0.04 cm^{-1} relative to the H_2O and HDO lines.

The spectra were recorded using a multipass gas cell with an optical path length of 800 cm at temperatures in the interval 293–300°K. The partial pressures of D_2O, HDO, and H_2O in the gas mixtures were varied, depending on the measurement temperature, in the ranges of 1.78–2.82, 19–66, and 4–13 Pa, respectively, for the three species. About 1400 absorption lines were recorded in the investigated spectral range 3690–4190 cm^{-1}.

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